

Amendments to the Claims

This listing of claims replaces all prior versions and listings of claims in the application.

Listing of Claims

1. (Currently Amended) A luminescent device comprising:

an organic luminescent element comprising:

an anode;

a cathode; and

a hole transporting layer region provided between the anode and the cathode, the hole transporting layer region comprising a first layer, a second layer, and a mixed layer provided between the first layer and the second layer;

wherein the first layer includes a hole injecting material, the mixed layer includes the hole injecting material and a hole transporting material, and the second layer includes the hole transporting material,

wherein the hole injecting material is smaller in ionization potential than the hole transporting material,

wherein the hole transporting material is larger in hole mobility than the hole injecting material, and

wherein there is a concentration gradient such that a concentration of the hole transporting material is increased toward the cathode from the anode and a concentration of the hole injecting material is decreased toward the cathode from the anode.

2. (Canceled)

3. (Previously Presented) A luminescent device according to claim 1, wherein the hole injecting material comprises a phthalocyanine compound.

4. (Previously Presented) A luminescent device according to claim 1, wherein the hole transporting material comprises an aromatic amine-based compound.

5. (Original) A luminescent device according to claim 1, wherein the organic luminescent element has a luminescence from a triplet excited state.

6. (Previously Presented) A luminescent device according to claim 1, wherein the luminescent device is an electric appliance selected from the group consisting of a display device, a video camera, a digital camera, an image reproducing device, a mobile portable computer, a personal computer, a cellular phone, and an audio device.

7. (Currently Amended) A luminescent device comprising:

an organic luminescent element comprising:

an anode;

a cathode; and

an electron transporting ~~layer~~ region provided between the anode and the cathode, the electron transporting ~~layer~~ region comprising a first layer, a second layer, and a mixed layer provided between the first layer and the second layer;

wherein the first layer includes an electron injecting material, the mixed layer includes an electron transporting material and the electron injecting material, and the second layer includes the electron transporting material,

wherein the electron injecting material is larger in electron affinity than the electron transporting material,

wherein the electron transporting material is larger in electron mobility than the electron injecting material, and

wherein there is a concentration gradient such that a concentration of the electron injecting material is increased toward the cathode from the anode and a concentration of the electron transporting material is decreased toward the cathode from the anode.

8. (Canceled)

9. (Previously Presented) A luminescent device according to claim 7, wherein the electron injecting material is selected from the group consisting of alkali metal halogenide, a metal complex having a quinoline skeleton, a metal complex having a benzoquinoline skeleton, an oxadiazole derivative, or a triazole derivative.

10. (Previously Presented) A luminescent device according to claim 7, wherein the electron transporting material is selected from the group consisting of a metal complex having a quinoline skeleton, a metal complex having a benzoquinoline skeleton, an oxadiazole derivative, a triazole derivative, or a phenanthroline derivative.

11. (Original) A luminescent device according to claim 7, wherein the organic luminescent element has a luminescence from a triplet excited state.

12. (Previously Presented) A luminescent device according to claim 7, wherein the luminescent device is an electric appliance selected from the group consisting of a display device, a video camera, a digital camera, an image reproducing device, a mobile portable computer, a personal computer, a cellular phone, and an audio device.

13-24. (Canceled)

25. (Previously Presented) A luminescent device comprising:
an organic luminescent element comprising:

an anode;

a cathode;

a luminescent layer provided between the anode and the cathode; and

a blocking layer adjacent to the luminescent layer, being provided between the anode and the cathode;

wherein the blocking layer comprises a blocking material and a material contained in the luminescent layer,

wherein an energy difference between a highest occupied molecular orbit and a lowest unoccupied molecular orbit in the blocking material is larger than an energy difference between a highest occupied molecular orbit and a lowest unoccupied molecular orbit in a material contained in the luminescent layer, and

wherein there is a concentration gradient that a concentration of the material contained in the luminescent layer is decreased toward the cathode from the anode and a concentration of the blocking material is increased toward the cathode from the anode.

26. (Canceled)

27. (Original) A luminescent device according to claim 25, wherein the blocking material is selected from the group consisting of an oxadiazole derivative, a triazole derivative, or a phenanthroline derivative.

28. (Original) A luminescent device according to claim 25, wherein the organic luminescent element presents luminance caused from a triplet excited state.

29. (Previously Presented) A luminescent device according to claim 25, wherein the luminescent device is an electric appliance selected from the group consisting of a display device, a video camera, a digital camera, an image reproducing device, a mobile portable computer, a personal computer, a cellular phone, and an audio device.

30. (Previously Presented) A luminescent device comprising:

an organic luminescent element comprising:

an anode;

a cathode;

a first mixed region contiguous to the anode, comprising a hole injecting material and a hole transporting material;

a second mixed region contiguous to the first region, comprising the hole transporting material and a host material;

a third mixed region contiguous to the second mixed region, comprising the host material and a blocking material; and

a fourth mixed region provided between the third mixed region and the cathode, comprising an electron injecting material and an electron transporting material,

wherein there is at least one concentration gradient in the first region such that a concentration of the hole injecting material is decreased toward the second region from the anode and a concentration of the hole transporting material is increased toward the second region from the anode, in the second region such that a concentration of the hole transporting material is decreased toward the third region from the first region and a concentration of the host material is increased toward the third region from the first region, and in the third region such that a concentration of the host material is decreased toward the fourth region from the second region and a concentration of the blocking material is increased toward the fourth region from the second region.

31-41. (Canceled)

42. (Previously Presented) A luminescent device:

comprising an organic luminescent element comprising:

an anode;

a cathode;

a hole injecting region adjacent to the anode; and

an organic compound layer provided between the hole injecting region and the cathode, comprising a hole transporting region comprising a hole transporting material and an electron transporting region comprising an electron transporting material;

wherein the hole transporting region is disposed nearer to the anode than the electron transporting region,

wherein a mixed region comprising the hole transporting material and the electron transporting material is provided between the hole transporting region and the electron transporting region, and

wherein there is a concentration gradient in the mixed region that a concentration of the hole transporting material is decreased toward the cathode from the anode and a concentration of the electron transporting material is increased toward the cathode from the anode.

43. (Canceled)

44. (Original) A luminescent device according to claim 42, wherein a luminescent material is doped in the mixed region.

45. (Original) A luminescent device according to claim 42, wherein a luminescent material is doped in a portion in the mixed region.

46. (Original) A luminescent device according to claim 42, wherein a blocking material is doped in the mixed region and an energy difference between a highest occupied molecular orbit and a lowest unoccupied molecular orbit in the blocking material is larger than energy differences in the hole transporting material and in the electron transporting material.

47. (Original) A luminescent device according to claim 46, wherein the blocking material is doped in a portion of the mixed region.

48. (Original) A luminescent device according to claim 46, wherein a luminescent material and the blocking material are doped in the mixed region.

49. (Original) A luminescent device according to claim 48, wherein a portion added the luminescent material is disposed nearer to the anode than a portion added the blocking material.

50. (Original) A luminescent device according to one of claim 44 to 45 or one of claim 48 to 49, wherein the luminescent material presents luminance caused from a triplet excited state.

51. (Original) A luminescent device according to claim 48, wherein the ratio of a mass of the hole transporting material to the total mass of the hole transporting material and the electron transporting material in the mixed region is 10 % or more and 90 % or less.

52. (Original) A luminescent device according to claim 48, wherein the mixed region has a thickness of 10 nm or more and 100 nm or less.

53. (Previously Presented) A luminescent device according to claim 42, wherein the luminescent device is an electric appliance selected from the group consisting of a display device, a video camera, a digital camera, an image reproducing device, a mobile portable computer, a personal computer, a cellular phone, and an audio device.

54. (Previously Presented) A luminescent device comprising:

an organic luminescent element comprising:

an anode;

a cathode;

an electron injecting region contacted with the cathode; and

an organic compound layer provided between the anode and the electron injecting region, comprising a hole transporting region comprising a hole transporting material and an electron transporting region comprising an electron transporting material;

wherein the hole transporting region is disposed nearer to the anode than the electron transporting region,

wherein a mixed region comprising the hole transporting material and the electron transporting material is provided between the hole transporting region and the electron transporting region, and

wherein there is a concentration gradient in the mixed region that a concentration of the hole transporting material is decreased toward the cathode from the anode and a concentration of the electron transporting material is increased toward the cathode from the anode.

55. (Canceled)

56. (Original) A luminescent device according to claim 54, wherein a luminescent material is doped in the mixed region.

57. (Original) A luminescent device according to claim 54, wherein a luminescent material is doped in a portion in the mixed region.

58. (Original) A luminescent device according to claim 54, wherein a blocking material is doped in the mixed region and an energy difference between a highest occupied molecular orbit and a lowest unoccupied molecular orbit in the blocking material is larger than energy differences in the hole transporting material and in the electron transporting material.

59. (Original) A luminescent device according to claim 58, wherein the blocking material is doped in a portion of the mixed region.

60. (Original) A luminescent device according to claim 58, wherein a luminescent material and the blocking material are doped in the mixed region.

61. (Original) A luminescent device according to claim 60, wherein a portion added the luminescent material is disposed nearer to the anode than a portion added the blocking material.

62. (Original) A luminescent device according to one of claim 56 to 57 or one of claim 60 to 61, wherein the luminescent material presents luminance caused from a triplet excited state.

63. (Original) A luminescent device according to claim 60, wherein the ratio of a mass of the hole transporting material to the total mass of the hole transporting material and the electron transporting material in the mixed region is 10 % or more and 90 % or less.

64. (Original) A luminescent device according to claim 60, wherein the mixed region has a thickness of 10 nm or more and 100 nm or less.

65. (Previously Presented) A luminescent device according to claim 54, wherein the luminescent device is an electric appliance selected from the group consisting of a display device, a video camera, a digital camera, an image reproducing device, a mobile portable computer, a personal computer, a cellular phone, and an audio device.

66. (Previously Presented) A luminescent device comprising:
an organic luminescent element comprising:

an anode;

a cathode;

a hole injecting region adjacent to the anode;

an electron injecting region adjacent to the cathode; and

an organic compound layer provided between the hole injecting region and the electron injecting region, comprising a hole transporting region comprising a hole transporting material and an electron transporting region comprising an electron transporting material;

wherein the hole transporting region is disposed nearer to the anode than the electron transporting region,

wherein a mixed region comprising the hole transporting material and the electron transporting material is provided between the hole transporting region and the electron transporting region, and

wherein there is a concentration gradient in the mixed region that a concentration of the hole transporting material is decreased toward the cathode from the anode and a concentration of the electron transporting material is increased toward the cathode from the anode.

67. (Canceled)

68. (Original) A luminescent device according to claim 66, wherein a luminescent material is doped in the mixed region.

69. (Original) A luminescent device according to claim 66, wherein a luminescent material is doped in a portion in the mixed region.

70. (Original) A luminescent device according to claim 66, wherein a blocking material is doped in the mixed region and an energy difference between a highest occupied molecular orbit and a lowest unoccupied molecular orbit in the blocking material is larger than energy differences in the hole transporting material and in the electron transporting material.

71. (Original) A luminescent device according to claim 70, wherein the blocking material is doped in a portion of the mixed region.

72. (Original) A luminescent device according to claim 70, wherein a luminescent material and the blocking material are doped in the mixed region.

73. (Original) A luminescent device according to claim 72, wherein a portion added the luminescent material is disposed nearer to the anode than a portion added the blocking material.

74. (Original) A luminescent device according to one of claim 69 to 70 or one of claim 72 to 73, wherein the luminescent material presents luminance caused from a triplet excited state.

75. (Original) A luminescent device according to claim 72, wherein the ratio of a mass of the hole transporting material to the total mass of the hole transporting material and the electron transporting material in the mixed region is 10 % or more and 90 % or less.

76. (Original) A luminescent device according to claim 72, wherein the mixed region has a thickness of 10 nm or more and 100 nm or less.

77. (Previously Presented) A luminescent device according to claim 66, wherein the luminescent device is an electric appliance selected from the group consisting of a display

device, a video camera, a digital camera, an image reproducing device, a mobile portable computer, a personal computer, a cellular phone, and an audio device.

78. (Original) A luminescent device comprising:
an organic luminescent element comprising:

an anode;

a cathode; and

an organic compound layer provided between the anode and the cathode,
comprising a hole transporting region comprising a hole transporting material and an electron
transporting region comprising an electron transporting material;

wherein a mixed region is provided between the hole transporting region and the electron
transporting region, comprising the hole transporting material and the electron transporting
material,

wherein a luminescent region added a luminescent material is provided in the mixed
region.

79. (Original) A luminescent device according to claim 78, wherein the mixed region
comprises the hole transporting material and the electron transporting material at a constant ratio.

80. (Original) A luminescent device according to claim 78, wherein the luminescent
region is a part of the mixed region.

81. (Original) A luminescent device according to claim 78, wherein a blocking material is
doped in a portion of the mixed region, in which an energy difference between a highest
occupied molecular orbit and a lowest unoccupied molecular orbit is large as compared with
energy differences in the hole transporting material and the electron transporting material.

82. (Original) A luminescent device according to claim 81, wherein the luminescent
region is disposed nearer to the anode than the portion added the blocking material.

83. (Original) A luminescent device according to claim 78, wherein the luminescent material presents luminance caused from a triplet excited state.

84. (Original) A luminescent device according to claim 78, wherein the ratio of a mass of the hole transporting material to the total mass of the hole transporting material and the electron transporting material in the mixed region is 10 % or more and 90 % or less.

85. (Original) A luminescent device according to claim 78, wherein the mixed region has a thickness of 10 nm or more and 100 nm or less.

86. (Previously Presented) A luminescent device according to claim 78, wherein the luminescent device is an electric appliance selected from the group consisting of a display device, a video camera, a digital camera, an image reproducing device, a mobile portable computer, a personal computer, a cellular phone, and an audio device.

87. (Original) A luminescent device comprising:

an organic luminescent element comprising:

an anode;

a cathode;

a hole injecting region adjacent to the anode; and

an organic compound layer provided between the hole injecting region and the cathode, comprising a hole transporting region comprising a hole transporting material and an electron transporting region comprising an electron transporting material;

wherein a mixed region is provided between the hole transporting region and the electron transporting region, comprising the hole transporting material and the electron transporting material, and

wherein a luminescent region added a luminescent material is provided in the mixed region.

88. (Original) A luminescent device according to claim 87, wherein the mixed region comprises the hole transporting material and the electron transporting material at a constant ratio.

89. (Original) A luminescent device according to claim 87, wherein the luminescent region is a part of the mixed region.

90. (Original) A luminescent device according to claim 87, wherein a blocking material is doped in a portion of the mixed region, in which an energy difference between a highest occupied molecular orbit and a lowest unoccupied molecular orbit is large as compared with energy differences in the hole transporting material and the electron transporting material.

91. (Original) A luminescent device according to claim 90, wherein the luminescent region is disposed nearer to the anode than the portion added the blocking material.

92. (Original) A luminescent device according to claim 87, wherein the luminescent material presents luminance caused from a triplet excited state.

93. (Original) A luminescent device according to claim 87, wherein the ratio of a mass of the hole transporting material to the total mass of the hole transporting material and the electron transporting material in the mixed region is 10 % or more and 90 % or less.

94. (Original) A luminescent device according to claim 87, wherein the mixed region has a thickness of 10 nm or more and 100 nm or less.

95. (Previously Presented) A luminescent device according to claim 87, wherein the luminescent device is an electric appliance selected from the group consisting of a display device, a video camera, a digital camera, an image reproducing device, a mobile portable computer, a personal computer, a cellular phone, and an audio device.

96. (Original) A luminescent device comprising:

an organic luminescent element comprising:

an anode;

a cathode;

an electron injecting region adjacent to the cathode; and

an organic compound layer provided between the electron injecting region and the cathode, comprising a hole transporting region comprising a hole transporting material and an electron transporting region comprising an electron transporting material;

wherein a mixed region is provided between the hole transporting region and the electron transporting region, comprising the hole transporting material and the electron transporting material, and

wherein a luminescent region added a luminescent material is provided in the mixed region.

97. (Original) A luminescent device according to claim 96, wherein the mixed region comprises the hole transporting material and the electron transporting material at a constant ratio.

98. (Original) A luminescent device according to claim 96, wherein the luminescent region is a part of the mixed region.

99. (Original) A luminescent device according to claim 96, wherein a blocking material is doped in a portion of the mixed region, in which an energy difference between a highest occupied molecular orbit and a lowest unoccupied molecular orbit is large as compared with energy differences in the hole transporting material and the electron transporting material.

100. (Original) A luminescent device according to claim 99, wherein the luminescent region is disposed nearer to the anode than the portion added the blocking material.

101. (Original) A luminescent device according to claim 96, wherein the luminescent material presents luminance caused from a triplet excited state.

102. (Original) A luminescent device according to claim 96, wherein the ratio of a mass of the hole transporting material to the total mass of the hole transporting material and the electron transporting material in the mixed region is 10 % or more and 90 % or less.

103. (Original) A luminescent device according to claim 96, wherein the mixed region has a thickness of 10 nm or more and 100 nm or less.

104. (Previously Presented) A luminescent device according to claim 96, wherein the luminescent device is an electric appliance selected from the group consisting of a display device, a video camera, a digital camera, an image reproducing device, a mobile portable computer, a personal computer, a cellular phone, and an audio device.

105. (Original) A luminescent device comprising:
an organic luminescent element comprising:
an anode;
a cathode;
a hole injecting region adjacent to the anode;
an electron injecting region adjacent to the cathode; and
an organic compound layer provided between the electron injecting region and the hole injecting region, comprising a hole transporting region comprising a hole transporting material and an electron transporting region comprising an electron transporting material;
- wherein a mixed region is provided between the hole transporting region and the electron transporting region, comprising the hole transporting material and the electron transporting material, and
wherein a luminescent region added a luminescent material is provided in the mixed region.

106. (Original) A luminescent device according to claim 105, wherein the mixed region comprises the hole transporting material and the electron transporting material at a constant ratio.

107. (Original) A luminescent device according to claim 105, wherein the luminescent region is a part of the mixed region.

108. (Original) A luminescent device according to claim 105, wherein a blocking material is doped in a portion of the mixed region, in which an energy difference between a highest occupied molecular orbit and a lowest unoccupied molecular orbit is large as compared with energy differences in the hole transporting material and the electron transporting material.

109. (Original) A luminescent device according to claim 108, wherein the luminescent region is disposed nearer to the anode than the portion added the blocking material.

110. (Original) A luminescent device according to claim 105, wherein the luminescent material presents luminance caused from a triplet excited state.

111. (Original) A luminescent device according to claim 105, wherein the ratio of a mass of the hole transporting material to the total mass of the hole transporting material and the electron transporting material in the mixed region is 10 % or more and 90 % or less.

112. (Original) A luminescent device according to claim 105, wherein the mixed region has a thickness of 10 nm or more and 100 nm or less.

113. (Previously Presented) A luminescent device according to claim 105, wherein the luminescent device is an electric appliance selected from the group consisting of a display device, a video camera, a digital camera, an image reproducing device, a mobile portable computer, a personal computer, a cellular phone, and an audio device.

114. (Previously Presented) A luminescent device comprising:
an organic luminescent element comprising:

- an anode;
- a cathode;

a first mixed region adjacent to the anode, comprising a hole injecting material and a hole transporting material;

a second mixed region adjacent to the cathode, comprising an electron injecting material and an electron transporting material;

a third mixed region provided between the first mixed region and the second mixed region, comprising the hole transporting material and the electron transporting material, and

wherein there is a concentration gradient in the first mixed region that a concentration of the hole transporting material is decreased toward the third region from the anode and a concentration of the hole injecting material is increased toward the third region from the anode, in the second region that a concentration of the electron transporting material is increased toward the third region from the cathode and a concentration of the electron injecting material is decreased toward the third region from the cathode, and in the third region that a concentration of the electron transporting material is decreased toward the first region from the second region and a concentration of the hole transporting material is increased toward the first region from the second region.

115-117. (Canceled)

118. (Original) A luminescent device according to claim 114, wherein a luminescent material is doped in a portion of the third region.

119. (Original) A luminescent device according to claim 118, wherein the luminescent material is a triplet luminescent diode.

120. (Previously Presented) A luminescent device according to claim 114, wherein the luminescent device is an electric appliance selected from the group consisting of a display device, a video camera, a digital camera, an image reproducing device, a mobile portable computer, a personal computer, a cellular phone, and an audio device.

121. (Previously Presented) A luminescent device comprising:
an organic luminescent element comprising:
 an anode;
 a cathode;
 a first mixed region contiguous to the anode, comprising a hole injecting material
and a hole transporting material;
 a second mixed region contiguous to the first region, comprising the hole
transporting material and a host material;
 a third mixed region contiguous to the second mixed region, comprising the host
material and a blocking material;
 a fourth mixed region provided between the third mixed region and the cathode,
comprising the blocking material and an electron injecting material; and
 wherein there is at least one concentration gradient in the first region that a concentration
of the hole injecting material is decreased toward the second region from the anode and a
concentration of the hole transporting material is increased toward the second region from the
anode, in the second region that a concentration of the hole transporting material is decreased
toward the third region from the first region and a concentration of the host material is increased
toward the third region from the first region, and in the third region that a concentration of that
host material is decreased toward the fourth region from the second region and a concentration of
the blocking material is increased toward the fourth region from the second region.

122-124. (Canceled)

125. (Original) A luminescent device according to claim 121, wherein there is a
concentration gradient in the fourth region that a concentration of the blocking material is
decreased toward the cathode from the third region and a concentration of the electron injecting
material is increased toward the cathode from the third region.

126. (Original) A luminescent device according to claim 121, wherein a luminescent
material is doped in a portion of both second region and third region.

127. (Original) A luminescent device according to claim 126, wherein the luminescent material is a triplet luminescent diode.

128. (Original) A luminescent device according to claim 121, wherein the blocking material is an electron transporting material.